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# CHEMURGY

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CHEMURGY means chemistry at work. The name is new, and is said to be a combination of the Egyptian word chem and the Greek word ergon. The name originated in the United States around 1935 and is now fairly well established in this country and in use to some extent in other countries. Farm chemurgy simply means chemistry at work on the farm, or better still, at work on agricultural commodities in the hope of expanding the markets for such products. Advocates of the chemurgic idea are known as chemurgists.

It isn't hard to trace the farm chemurgic development in this country. Some say the seeds were planted during World War I when farmers were urged to increase the production of food and feed crops. They responded with bumper crops both during and for several years following the war and enjoyed good markets for most of their products as long as the war lasted and for a short time thereafter. But the fighting nations increased the production of crops at home as fast as possible after the war. This coupled with purchasing power difficulties of some of our customer nations gradually decreased the foreign demand for some of our crops. The situation in this country grew steadily worse. Surpluses piled up, and the prices of farm products began to tumble.

It was obvious by the summer of 1921 that something had to be done, but nobody knew exactly what to do. Conditions continued to get worse as the years passed and became acute following the crash of the stock market in the fall of 1929. It was about this time that Henry Ford, Thomas A. Edison, Wheeler McMillen, Francis Garvan, William J. Hale, Carl Fritsche, and others began to advocate the use of chemistry to search for large scale industrial outlets for farm crops. They not only advocated the use of surpluses of the old-established crops like corn and cotton, but the growing of new crops wholly for industrial purposes. This idea grew and spread until it was decided to hold a conference on the subject. Invitations were mailed hopefully for a "Conference on Agriculture, Industry, and Science." The sponsors were Ford, the Chemical Foundation, National Grange, Farm Bureau, and the Council of Agricultural Organizations. The sponsors hoped for an attendance of around 75 and were delighted when more than 300 persons from all walks of life came to the two-day meeting in the Dearborn Inn, at Dearborn, Michigan, on May 7, and 8, 1935. Col. Frank Knox, Irenee duPont, and Dr. Karl T. Compton were among the eminent speakers. At the close of the meeting Mr. Garvan appointed a committee to carry on the ideas discussed at the Conference. The committee met in June, formed a permanent organization which they called the Farm Chemurgic Council to which was later added the word National. The word "farm" is now usually omitted from the title since "chemurgy" means putting chemistry to work on the industrial utilization of farm-grown products. The word chemurgic was decided upon for a name because it was new and short, and because it would fit into a one-column newspaper headline. The committee knew it would need publicity to put over a new name and that such shop-worn names as "Technocracy", and

"Non-food Utilization of Farm Products", would not attract the desired attention.

Chemistry has been used as a working tool by scientists for many years. There is nothing new about that, or about the use of some crops in industry. Corn has been used in the manufacture of cornstarch, alcohol, and other industrial products for a long time. The cornstarch industry was established long before the chemurgic movement was started. But a point to remember is, that while the cornstarch industry is old and classed as big business, yet the amount of corn used in the manufacture of starch is small compared with the amount used for food and feed. Approximately 90 percent of the harvested corn crop is used for feeding livestock. More than 5 percent is used for human food which represents a per capita consumption of about 65 pounds or a little over a bushel of raw grain per person. This means that less than 5 percent of the corn produced finds its way into industrial channels. That's true of most of the other crops that are used by industry. The amount used is usually small compared with total production. The primary uses for farm crops is for food, clothing, and shelter. That's been true for ages. The new angle came into the picture with the chemurgic movement to use chemistry in a big way to search for industrial outlets for farm products on a large scale.

The question is sometimes asked why the chemurgic movement wasn't started long before it was. There were surpluses of some crops as far back as the early twenties, more than 10 years before the Chemurgic Council was organized. The answer to that is largely historical. In the early days of this country there was a scarcity rather than a surplus of farm crops. Practically everything the farmer could produce was needed for food, clothing, and shelter. There was also a good demand for some of our crops from abroad. Crop production increased as the years went by and as the country became better established but with a few exceptions surpluses did not become burdensome until after the first World War. The industrial utilization of crops was started in this country around 1850 when Kingsford started the commercial production of starch from corn. Portions of other crops have been used for industrial purposes from time to time, but with the exception of the work by the Department of Agriculture no special effort had been made to encourage the use of large quantities of crops in industry until the chemurgic movement got under way.

At the Dearborn conference in 1935 the chemurgists talked about converting agricultural commodities into industrial products and wealth; about making motor fuel from corn; steering wheels from soybeans; and building board from wheat straw. They talked about using crops to take the place of some of our rapidly vanishing natural resources, and argued that crops are not food alone but potential raw materials for factories which could use the unemployed in processing farm crops for industrial use. The chemurgists went on record as favoring: (1) The development of new, non-food uses for established farm crops, (2) the establishment of new crops for new or old uses, and (3) the discovery of profitable uses for agricultural wastes or residues, such as straws, stalks, husks, and hulls. The idea of using surplus crops in industry to help keep farm income on a more stable basis sounded like good logic. It was such a new approach to the farm surplus problem that it attracted the attention of a great many people and made front page stories for newspapers in many parts of the country. The chemurgists were so pleased with the success of their first meeting that they

held another in 1936 and planned for annual meetings thereafter with State and local meetings in between.

The chemurgic movement grew and spread until Congress in 1938 authorized the Secretary of Agriculture to establish four large Regional Research Laboratories to search primarily for industrial outlets for farm crops, particularly the surplus crops. This marked the beginning of the Federal Government's entry into the chemurgic field on a large scale, and made it possible to attack the surplus problem on a nation-wide basis. The Laboratories are operated by the Bureau of Agricultural and Industrial Chemistry of the Department's Agricultural Research Administration. The Bureau of Agricultural and Industrial Chemistry is sometimes referred to as the chemurgic agency of the Department of Agriculture since the four Regional Laboratories and some smaller laboratories of the Bureau spen most of their time searching for industrial outlets for agricultural commodities. One laboratory was established in each of the four major farm producing areas of the country. They were located at Peoria, Illinois, for the North Central States; New Orleans, for the South; Philadelphia, for the East; and at Albany, in the San Francisco Bay area for the West. It cost about 2 million dollars each to build and equip these laboratories and each receives an appropriation in excess of one million dollars a year to carry on the research. Approximately 1,200 persons are employed in these research centers, and about two-thirds of them are chemists, physicists, and other highly trained scientists. It took about 2 years to build and equip these laboratories which were occupied in 1941. They are largely the result of the chemurgic movement that was started in this country in the early thirties, and represent the greatest effort that is being made anywhere in the world to find industrial outlets for agricultural commodities.

Research is under way in these laboratories on the following commodities:

Northern Laboratory

Corn, wheat and other cereal crops
Soybeans and other oilseed crops
Agricultural residues, such as straws and stalks

Southern Laboratory

Cotton
Sweetpotatoes
Peanuts and other oil seed crops.

Eastern Laboratory

Tobacco
Apples and other fruits
Potatoes
Milk products
Vegetables
Animal fats and oils
Tanning materials, hides, skins, and leather

Western Laboratory

Fruits including apples
Vegetables including potatoes
Alfalfa
Poultry products and byproducts
Wheat

Each one of these chemurgic laboratories has already contributed a number of wartime and peacetime developments. Brief mention of a few outstanding accomplishments will illustrate how research in these centers is expanding the use of agricultural commodities in the industrial field.

Scientists in the Northern Laboratory quickly increased the yield of penicillin so it could be produced on a commercial scale. They did this by feeding the mold that produces penicillin on a diet composed largely of two agricultural products--corn steeping liquor, a byproduct from the manufacture of cornstarch, and lactose or milk sugar. About 11 million pounds of milk sugar and 12 million pounds of corn steeping liquor, valued at $2,250,000 and $234,000 respectively, are used annually in the production of penicillin. The value of penicillin produced in 1946 is estimated at well over a hundred million dollars, but money value cannot be placed on the human lives saved as a result of the large-scale commercial production of penicillin made possible by the chemurgic scientists so shortly after our entry into the war.

Research in the Southern Laboratory has shown that better automobile tire cord can be made from cotton by using varieties of cotton selected specifically for this purpose on the basis of their physical properties. Passenger car tires in the 6.00-16 size, made from standard and improved cotton cord ran over 68,000 miles, with one recapping, at a sustained highway speed of 60 miles an hour. The tests were made by the Army Ordnance Department at its proving grounds at San Antonio, Texas. These tests showed three things: (1) That cotton is adequate for passenger car tires, (2) that we can increase the mileage of light truck tires by making them from selected varieties of cotton, and (3) that the time has come for us to give more thought to the selection of varieties of cotton and other crops that possess the characteristics needed for the things we went to make. That is particularly true of crops grown for industrial or chemurgic purposes.

Chemists in the Eastern Laboratory are using buckwheat to produce a drug called rutin, which is extracted from the leaves and blossoms of the green plant. Rutin gives promise of being beneficial in treating persons who are suffering from high blood pressure associated with increased capillary fragility. The drug is now in commercial production. It will require more than a million pounds of rutin a year to meet medicinal requirements if present promising results are substantiated. This would mean that about 50,000 acres of buckwheat would be needed each year for the production of this drug. This would be in addition to the normal acreage of buckwheat that is usually grown for grain. The interesting angle to this development is that in producing buckwheat for rutin more than one crop can be grown in a season since the plants are cut green and not allowed to mature as when the plants are grown for the grain for making buckwheat flour.

Western Laboratory scientists are trying to find a market for chicken feathers. It is estimated that around 175 million pounds of chicken feathers were wasted each year. Fundamental research looking toward the industrial utilization of at least a part of this waste material has been going on in the Western Laboratory for a number of years. The research has led to the production, on a pilot-plant scale, of keratin or chicken-feather fiber. The scientists have found that red feathers from breeds like the Rhode Island Reds make a red fiber that closely resembles red hair which can be used in making wigs for show-windor manikins. White feathers produce a blond-colored fiber.

One of the laboratories is making a synthetic fiber from peanut protein. Another is making a synthetic fiber from corn. Another laboratory

has developed a method for making a bristle from casein that is being used in the manufacture of paint brushes. Research in one laboratory has resulted in the commercial use of a soft-grit blasting material that is made from two waste products--corncobs and rice hulls. This material is now being used in regular air-blasting equipment for cleaning carbon, oil, and other deposits from automobile and airplane engines. It gives the metal a clean dry surface without grinding away or reducing the size of the cleaned parts, and is about 10 times faster than the work can be done by hand.

The Bureau of Agricultural and Industrial Chemistry has also developed a method for making a high grade white starch from sweetpotatoes. Tests show that this starch can be used for the same purposes that imported root starches are used for. A large multimillion dollar plant was constructed in the Florida Everglades for the manufacture of this starch, but some difficulty has been encountered in getting sufficient yields of potatoes per acre and in getting machinery for handling the production and harvesting of the potatoes. Hand labor, which has been used largely in the production of sweetpotatoes, is too expensive for crops that are to be used in industry. If crops are to become the raw material for industry they must be produced at a cost competitive with raw material from nonagricultural sources. Factories can't afford to pay high prices for raw materials that have to be processed. That's one reason why more crops are not being used in the chemurgic or industrial field. Agricultural engineers are at work on this phase of the chemurgic problem, but it takes time to develop and perfect machines to do the work that has been done by hand for more than a hundred years. All of these changes take time, and that is why it is not possible to change suddenly from the production of farm crops for food, clothing, and shelter to the production of crops for industrial purposes. The chemurgic idea is sound, and the movement in that direction is making statisfactory progress with the four Regional Research Laboratories leading the procession and with increasing interest being taken by farm, industrial, and educational organizations all looking toward the increased utilization of agricultural commodities in the industrial field.

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